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ABSTRACT

Data on the development of intelligence and the concept of giftedness are interpreted for use in the classroom and are applied to the development of strategies to optimize learning. The Integrative Education Model is introduced, with its purpose of empowering the learner physically, emotionally, cognitively, and intuitively. The teacher's role is described as central to the establishment of the optimal learning environment, as the teacher sets the tone, establishes the organization, facilitates the goals, and influences the productivity of each class member. The human brain is described, and functions of the brain are discussed, with the integration of these functions seen as allowing human intelligence to express itself most fully. A number of specific activities are offered to illustrate the affective-cognitive interaction of left brain-right brain functioning. (JDD)

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Optimizing Learning

A Leadership Accessing Monograph

Education of Gifted and Talented Youth

Dr. Barbara Clark, Professor of Education
California State University, Los Angeles

Indiana Department of Education
Office of Gifted and Talented Education
H. Dean Evans, Superintendent

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Introduction

In the 1985-86 school year, Purdue University, in contract with the Indiana Department of Education, organized the Leadership Accessing Project, a program that provided state-of-the-art information and guidelines concerning the development of programs for gifted and talented youth of Indiana school corporations. Five nationally and internationally recognized specialists in gifted and talented education, Ms. June Cox, Dr. Merle Karnes, Dr. Bruce Shore, Dr. Barbara Clark, and Dr. Abraham Tannenbaum, gave symposium addresses at three sites in Indiana (Indianapolis, Columbus, and South Bend). They addressed key issues and problems in identification, programming, and curriculum development for the gifted.

In addition, the symposiasts submitted the following monographs for publication by the Indiana Department of Education. Each includes thought provoking advice concerning program development for gifted and talented youth.

The symposiasts were selected by a project advisory committee using the following criteria: (1) the nominees were known by the project leaders and/or advisory committee members to have a significant message for gifted and talented education, and (2) the nominees had never or rarely presented their ideas in Indiana.

Introduction to Monograph

Barbara Clark believes that educators must "rethink" their belief systems regarding the development of intelligence and the concept of giftedness. New insights and knowledge from fields such as neurobiology and linguistics suggest that intelligence is a dynamic process, and Clark adds, giftedness requires constant stimulation. She cites data to prove that, if there is adequate stimulation, one's intellectual powers need not diminish with age. Like Karnes, Clark also considers infancy and preschool years as being of great importance.

She describes the human brain, and indicates which parts of the brain serve our major thinking/functioning activities. Clark notes the importance of both the specialization of various parts of the brain, but, also, the importance of interaction and extra support, after stating the belief that all children have "unlimited potential" and all can develop this unique potential if there is enough love, nutrients, nurturance, and appropriate stimulation.

Developing to the limits of one's potential depends a great deal upon one's parents, teachers, and the control one feels for one's own learning. Clark is convinced of the value of excellent teaching and of each individual's control over his learning — she calls this process "empowering the learner."

While the applicability of brain research to practical problems of human learning remains a controversial issue, Barbara Clark has provided in this monograph an excellent review of the possible applications in teaching. The monograph is especially strong in its focus on affective thinking activities and their potential interaction with cognitive functions. A number of specific activities are offered for use in the classroom to illustrate this affective-cognitive interaction of left brain — right brain functioning.

Overall Clark presents a highly optimistic view of teaching and learning and calls for a new orientation on the part of teachers to see all children as having great learning potential.

Biography of Dr. Barbara Clark

Dr. Barbara Clark is a professor in the Department of Special Education at California State University, Los Angeles, where she is coordinator for graduate programs in the area of Gifted Education. Dr. Clark is the author of the widely used text, *Growing Up Gifted, Second Edition*, published by Charles E. Merrill in 1983 and *Optimizing Learning* published by the same company in 1986. In addition, she has published many articles in a variety of professional journals and serves as a review editor for *The Gifted Child Quarterly, The Journal of Gifted Education*, and *The Roeper Review*.

Dr. Clark received her B.A. in Education from Wichita State University in 1955, her M.A. in Special Education, Learning Handicapped, from the University of California, Los Angeles, in 1966, and her Ed.D. degree in Special Education, Gifted Education, from the University of California, Los Angeles, in 1969. She has taught preschool children on television and both regular and gifted classes at the elementary level in public schools.

Dr. Clark is a Trustee and Director of the Center for Educational Excellence for Gifted and Highly Able Learners (CEEGHAL) and directs their New Age School Project each summer. She serves on the Board of Directors of the National Association for Gifted Children, and the California Association for the Gifted. She has been named to the Advisory Boards of the Gifted Children's Association, Los Angeles and the Professional Advocates for Gifted Education, Wichita State University, Wichita, Kansas.

Dr. Clark has presented major addresses and workshops at conferences and in school districts throughout the United States, in Canada, Mexico, and South Africa. Her current interest is the development of the Integrative Education Model which uses brain/mind research as the basis for optimizing teaching and learning.

Abstract

As a result of advanced technology, new information on human learning is available from neurobiology, psychology, physics, linguistics, and early learning research. Educators must now rethink their belief systems regarding the development of intelligence and the concept of giftedness. By viewing intelligence as a dynamic process giftedness can be seen to require constant stimulation and appropriate instruction. With the incorporation of these new data, teaching and learning can become more effective and efficient. This monograph will suggest how these data may be interpreted in the classroom and how they may serve as a base for the development of strategies to optimize learning. An educational model using this information will be introduced, The Integrative Education Model, and a rationale and strategies for using the Model will be presented. The purpose of the Model is to empower the learner physically, emotionally, cognitively, and intuitively. As a part of the Model, each function of the brain will be discussed with the integration of these functions seen as allowing human intelligence to express itself most fully. Teachers who have been intuitively using these ideas will find firm validation for their practices. As these new ideas become a part of the teacher's professional judgement and experience, the information will become meaningful and of benefit to all learners, especially those who are performing at the accelerated and advanced level we have labeled gifted. With this information we have the opportunity to optimize learning.

Optomizing Learning

This is a most exciting time in education. New information about learning is coming to us from many disciplines and with this new information, which is the result of new technology, we will be able to be more effective and more efficient as teachers. These new data have coalesced to set the stage for rethinking many of our belief systems and the practices that result from them. The research, especially from neurobiology, physics, psychology, linguistics, and early learning, affects our understanding of the development of intelligence and giftedness. It will not mean that we will need to throw out that which we are doing, but rather that we must add to and bring together in new ways the methods and ideas we have shared in the past. Many teachers have used methods intuitively that now have a firm basis in the research. This monograph will suggest how these data may be interpreted in the classroom and may serve as a base from which new ideas and strategies on optimizing learning can evolve. There is no one answer or any "right" way of doing this. As a professional it will be up to you to think of how these ideas would work best with the group of students with whom you work. Change or modify any of the material presented to be more appropriate for you and your situation. The research that has been done will only serve as a guide, and any information you add will make it a richer experience for your students.

The discussion must start at the very heart of what we as professionals are about, our perception of intelligence and our concept of giftedness. The first belief that must be called into question is the notion that intelligence comes with us when we are born, much as a completed package. For many years, it was thought that intelligence was fixed at birth and that there was little anyone could do to enhance or diminish it. A child was born gifted and even if neglected, "the cream would rise to the top," or certainly if the child was really gifted he or she could, "get along" without any special help. This belief system allowed the idea that the first 18 years of life involved a gradual growth in intelligence which plateaued at about the time the youngster left school. This plateau was thought to continue until about the age of 45 when it seemed evident that the brain died as learning curves began to fall and senility seemed to be inevitably ahead.

As one reviews this belief system, it would be well to remember that researchers at that time had only the behavior of mice in cages to interpret for patterns of growth and the development of the intellect. Human behavior had to be inferred from these patterns, and while many valuable learning theories came from these data, later technology showed that humans learn with far more complexity than rats. Many old theories were found to be only partially correct and some were seen to be quite misleading.

With a reanalysis of old data, Bloom (1964) found that the growth of intelligence was far different than we supposed. By four years-of-age, 50 percent of the deviation in measured intelligence thought to occur between birth and 18 was shown to have already taken place; by six, 80 percent was already in place. Longitudinal studies conducted by the Fels Foundation (Kagan & Moss, 1962) and the Berkeley Growth Studies (Bayley, 1968; Bayley & Schaefer, 1964) caused further question to be raised about the plateauing effect assumed after the age of 18. It was found that intelligence was not a static, but rather a dynamic process, as we are either growing and increasing intelligence or, if appropriate stimulation is not a part of the environment, diminishing it. One common phrase found in the writing of brain researchers is, "Use it or lose it." Our choice seems to be to use the intelligence we have or lose the ability to use it fully. Gifted youngsters cannot "get along"; intelligence does not plateau. We as educators at home and at school have a most important role to play in the development of intelligence and in the expression of giftedness.

The development of intelligence does not, as we had supposed, begin at birth, but rather at conception. The genetic program which is unique for each individual is already being impacted by the environment surrounding the mother and child (Verny, 1981). This interaction throughout the nine months of fetal development and even during the birthing procedure itself will change the very structure of the brain and its ability to support intelligence. Both the cognitive and the emotional life of the fetus are far more affected than was ever before imagined. The most dramatic changes continue to occur for the first three years of the child's life as sensitive and critical periods present opportunities for efficient learning. At this time the plasticity of the system diminishes, although, there will never be a time in our lives when the interaction between the genetic program and the environment will not be critical to the development of our potential.

There is even some question about the downward curve at the age of 45. In a study (Buell & Coleman, 1981) done comparing the density of dendritic growth between people in their 40s and 50s and those in their 70s and 80s, it was found that the development of intelligence may not be as limited by age as once was thought. The density of the dendritic system in the brain correlates positively to the level of intelligence measured in the individual. Buell and Coleman expected to find that during the ages of 40 and 50 people would be operating at the peak of their intellectual power and the density of the dendritic system would be at its maximum growth potential. They found this to be just as they expected. However, they also assumed that at the ages of 70 and 90 the brain would show a decline in the power of the dendrites. During that time, they expected to see sloughing off at the ends of the neural cells restricting the flow of oxygen and impairing the thinking process of the individual. While certainly they did find much actual loss within the aging brain, they amazingly found NEW DENDRITIC GROWTH among those who continued to challenge their thinking ability. This was not expected. Only those who suffered from the disease of senile dementia exhibited the degenerating pattern they had expected. Age may not be the greatest limit to our intellectual growth; it may instead be our belief system about aging.

With data indicating that neither the genetic program nor the aging process by itself are sufficient to limit the growth of the potential of individuals, it seems very clear that the old concept that intelligence is fixed at birth must now give way to the view that intelligence is dynamic and able to respond to challenge and stimulation throughout our lives. While genetics are very important to the development of intelligence, they do not provide limits; they instead provide for each individual a unique pattern of response. Giftedness is therefore not something that can be identified and expected to remain intact regardless of the opportunities provided. Giftedness is the result of the interaction of a most amazingly complex human brain system and its unique genetic program, with appropriate and responsive environment opportunities. Neither the genetic program nor the environment alone can create giftedness; it is the interaction between the two that allows human beings to become all they can be.

Can all children then become gifted? I believe that all children have unlimited potential that very early in their lives will begin to be limited. It will take a healthy genetic program, appropriate stimulation, sufficient nutrients, and a great deal of love for each human to develop their unique potential. We who have chosen to be educators or parents must now realize that we change children at the cellular level, not just their behavior. We must take an integral part in providing the opportunities for the creation of the gifted child.

To better understand how we may nurture this interaction and provide for the most brain-compatible and responsive environmental opportunities for learning it will be important to discover as much as we can about how the brain operates and about how the human beings learn. Let us start by looking at learning as the exchange of information among the neurons of the brain. There are approximately 100 billion neural cells within the brain allowing trillions and trillions of possible connections. The thinking process involves the passage of an electric impulse down the axon of one cell to a point where it comes close to the dendrite of a second cell. Here the electrical impulse is changed to a biochemical neurotransmitter capable of moving the impulse across the synaptic gap to the dendrites of the second cell. A change again occurs as the biochemistry once more becomes an electrical impulse and moves with great speed up the dendritic branch to the cell body. As chains of these relays are made, we have a thought. It is a process that you and I as educators directly affect.

As Rosensweig (1966) and Krech (1969) discovered, environmental stimulation directly changes the neural system. We do not create more neural cells, we develop more powerful neural cells from the cells we had at birth. These researchers have discovered that stimulation enriches the biochemistry of the cell body. This allows the impulse to travel from this cell more quickly and with more power.

In addition, through stimulation more neuroglial cells are created within the system. Part of the function of these cells is to support the neuron and to nurture it. Another function of neuroglia is to wrap itself around the axon much like insulation around a bare electrical wire resulting in better conduction of energy and making the exchange between cells more rapid and more powerful.

Increased stimulation also causes the branches of the dentrites to increase in density. This allows more complexity within the system and correlates highly with increases in intelligence. All of these basic changes within the brain are the result of stimulation and contribute to the power and complexity of the system. All are reflected in the behaviors we see with gifted children. Such children think with more speed, more complexity, and more power; behaviors that are the direct result of changes within the brain itself.

Understanding this learning process is one way to add to the control learners feel for their own learning, thereby empowering the learner and optimizing learning in the classroom. MacLean (1978) has provided an analogy that I have found helpful in teaching these concepts to my students. I believe it to be useful for students of all ages.

First, make a fist with each of your hands so that you can see the fingernails and then place your hands together with the fingernails touching. As you look down at your hands, they now form a very respectable model of the human brain. Wiggle your little fingers and you have identified the area through which vision enters the brain. Move your middle finger and you have located the motor area. The language area is just below the middle knuckle on the left hand. It is well supported by the specializations of the right hemisphere (right hand) through the corpus callosum (fingernails). There are more neural connections joining the right and left hemispheres of the brain than there are in any other part of the body. Clearly the interconnection or integration of the right and left hemisphere specializations is biologically intended. With this model we can now explore with the students just how they learn and how they can be responsible for improving their own learning ability.

Carefully separate the two hemispheres (hands); using the inside of the model of the brain (one hand) let us outline some of the basic brain functions. The arm/wrist area represents the most primitive and simplest system of the brain, the brain stem. In the lower brain stem and the innermost areas of the cerebrum, we find the seat of autonomic (automatic) function. This system relieves us of consciously processing each breath and each beat of our hearts. Those working in the area of biofeedback have in recent years shown us that we can, if we choose, bring the awareness of these automatic functions to consciousness, allowing us to monitor or change a destructive or inefficient process (Taylor & Bongar, 1976; Taylor, Tom & Ayers, 1981). Here we find the neural pathways for many higher brain centers. Here too are nuclei concerned with motor control and the communication link between the rest of the brain and the cerebellum located at the very base of the brain. Also located in this area, is the reticular formation, the physical basis for consciousness that plays a major role in keeping us awake and alert.

By partially unclenching your fist and looking at the palm of the hand, we can view the second system of the triune brain, the midbrain, or limbic system. One can see the ventricles of the brain that hold the cerebrospinal fluid, as well as the mounds and depressions of the limbic system itself. Here are the biochemicals that are activated by the emotions of the learner, and the interactions that enhance or inhibit memory. This area affects such diverse functions as anxiety, rage, sentimentality, and attention span. We depend on this area of the brain to combine internal and external experience to give us our feelings of personal identity and uniqueness. It is in this limbic area that affective feelings provide the connecting bridge between our inner and outer worlds, providing us with our construct of reality, our model of a possible world. This gateway to higher thought — to the cortical and neocortical functions — releases neurotransmitters to the cells of the cortex to either facilitate or inhibit their functioning. Novelty helps activate growth of this function (Restak, 1979). Feelings of pleasure and joy increase stimulation to this area (Sagan, 1977).

The exposed surface of your fingers and thumb held tightly together represent the convoluted mass known as the neocortex or the cerebrum. It is the largest area of the brain, comprising five-sixths of the total, and envelops the lower brain stem and the limbic system. Here sensory data are processed, decisions made, and action initiated. The neocortex is necessary for language and speech, its overriding functions involve the reception, storage, and retrieval of information.

The most recently evolved section of the neocortex, the prefrontal cortex (represented by the thumbs), provides for behaviors associated with planning, insight, empathy, introspection, and other bases for intuitive thought (MacLean, 1978). It is engaged in firming up intention deciding on action, and regulating our most complex behaviors (Restak, 1979).

Once students understand how the brain functions and what they can do to optimize that functioning they are ready to be more responsible for their learning and to participate in brain-compatible strategies and lessons. This is an excellent starting point for optimizing learning.

Integrating Brain Functions to Optimize Learning

As we begin to look at the possibility of optimizing learning, let us first consider the classroom environment. Because each learner is different, the environment must be able to support learning with a variety of levels and a range of pacing. The environment must be responsive to each learner if optimization is to be possible. Such an environment is more like a laboratory or workshop, rich in materials, and with simultaneous access to many learning activities. The emphasis is on experimenta-

tion and involvement.

In a truly supportive environment, the curriculum is responsive, flexible, and integrative. Thinking is supported by feelings, physical involvement, and intuitive processing. The ambience is productive, supportive, and positive with time given to build trust within the group. The energies of light, color, sound, and people are used to enhance the learning experience. Both the physical and the social-emotional environment must be of concern to the tacher. The environment must provide the students with the support and safety needed for them to feel empowered, motivated, cared for, and caring, feelings that will allow them to become truly effective learners.

The teacher is central to the establishment of the optimal learning environment. The teacher sets the tone, establishes the organization, and facilitates the goals. It is the teacher's concept of self that most influences the achievement level of the class (Aspy, 1969). By bringing coherent energy into the class, the teacher can influence the productivity of each class member. If the teacher is calm, and alert, the class will be also; a fragmented teacher will find a fragmented class in attendance (Millay, 1981).

Empowering the Learner Physically

The first key to creating this calm, tension-reduced environment is to involve first the teacher and then the students in learning the use of relaxation and tension reduction. One of the first clues leading to optimizing learning which came from the brain research laboratories was the suggestion that tension can reduce the ability to learn (Albrecht, 1979) and to remember even that which had already been learned (Hunt, 1982).

There are many strategies and forms of relaxation that can be employed to develop the skill of physically reducing tension. Among the most often mentioned are progressive relaxation (Jacobson, 1957); autogenic training, (Schultz & Luthe, 1959); mental rehearsal; and the use of visual imagery or fantasy. Tension reduction can be employed prior to taking a test, or when confronting a particularly difficult new concept. Relaxation techniques can be used to energize students who have problems with their concentration or who become less attentive as the day goes along. Becoming more alert, more attentive, more able to retain information faster and for longer periods of time are all results that can be expected as tension reduction tools are made available to students.

Too often schools forget that the first and one of the major support systems of the brain is its physical function. Except for some classes in physics, chemistry, and the arts, most of the support of movement and physical involvement have been removed from learning experiences by the third grade. In the process of optimizing learning, these physical strategies can play an important part.

We have discussed learning as the process of transmitting information between the neurons in the brain. We have used our hands to better understand this exchange of energy between neurons. In the following exercise we will use physical encoding as a strategy to better understand this process.

Physical Encoding of the Neural Process

Purpose: to teach the neural process by using physical movement
Time involved: 10 minutes
Materials needed: a glass of water
Preferred classroom structure: flexible seating and room for about 10 to 12 students to demonstrate the neural process
Teaching function: director/facilitator
Procedure:

1. Ask two students to volunteer to come to the front of the room and play the role of neurons. One student should stand on one side of the space, the other student at least eight feet away.
2. Ask for at least four volunteers to join the first "neuron" and become its axon. Direct these students to stand in front of each other and the "neuron" with their back to each forming a line. Ask them to hold the elbow of the person in front of them. The last person at the end of the axon chain becomes the synaptic terminal and will have a special function which will be revealed later.
3. Now invite as many others to come forward as wish to participate attaching themselves to each other or to the remaining "neuron" in any way they wish. These are the dendrites of

the neural system. Remind the students that there is a high correlation between the density of dendrites in the system and the intelligence of the system. Encourage many to participate.

4. Explain to the synaptic terminal that his/her special function is to hold and disperse the neurotransmitter fluid across the synaptic gap. You may wish to demonstrate.
5. Carefully review the process of the electrochemical impulse traveling first from one neuron, down the axon, then changing to a biochemical neurotransmitter at the end of the axon as the impulse crosses the synaptic gap. As the energy is received by the dendrites of the second neuron it is changed back to electrochemical energy and excites the entire system as the charge speeds to the cell body.
6. Approach the first "neuron" and excite it setting the process in motion. Repeat this process several times. You may wish to role play the difference when a gifted student is thinking. The entire process is speeded up and occurs with more intensity.
7. Ask the students to return to their seats and as a total group discuss the process.

This is just one example of how movement and physical encoding can support learning. Such strategies are valuable learning tools that can be used to strengthen the content of any subject or discipline. Use of such strategies can help students better understand complex or abstract concepts and enhance retention and retrieval capabilities.

By using relaxation and tension reduction and including the use of movement and physical encoding strategies in the classroom all students will become more empowered learners. Gifted students have a special need for the integration of these physical strategies. Very early many bright and able students find that their mind/brain is speeding ahead of their ability to carry-out the ideas they create. If attention is not given to helping such children integrate both the physical and the mental, a Cartesian split is likely to occur which will allow the youngster to focus exclusively on the activities of the mind/brain relegating the body and its abilities to a less favored position in their development. Physical encoding strategies will help the gifted student to see the value of body movement in the learning process.

Empowering the Learner Emotionally

The second system of the triune brain, known variously as the limbic system, the midbrain, and the emotional mind, houses the biochemical systems activated by the emotions of the learner as well as the interactions that enhance or inhibit memory. This area affects such diverse functions as anxiety, rage, sentimentality, and attention span. This system is often referred to as the gateway to higher thought: the cortical and neocortical functions. By the release of neurotransmitters from the limbic system, the cells of the cortex are either facilitated or inhibited in their function. Novelty activates growth in this area (Restak, 1979); feelings of pleasure and joy have been found to increase stimulation to this area (Sagan, 1977); and challenge and excitement help engage the processes of higher thought.

There are many areas of emotional development that could be included to empower the learner. Most are not new concerns. A decade ago educators heard a great deal about affective education. At that time it was treated as a separate process from the cognitive process and was used, if it was used at all, for short periods of time totally divorced from the content of the curriculum. The brain research now clearly shows this area of development to be most important for all learning. While emotional growth can be supported in many ways, we will explore the use of language for we find that empowering language and behavior in the classroom can make a significant difference in the emotional empowering of both student and teacher.

The language the teacher uses in the classroom can empower or take power from students. For example, notice how you feel when I say, "Go get that right now and bring it here," and then notice how you feel when I say, "I need that material. I would like you to bring it to me, please." There is a difference in your motivation to do the task, but more importantly your feelings about your own power and control have been diminished under the first condition. To optimize learning we do not want to take power away from the learner, rather we need to find more ways to share power with them. The literature on perceived control (Arlin & Whitley, 1978; Barnett & Kaiser, 1978; Caslyn, 1973; Matheny & Edwards, 1974; Thomas, 1980; Wang & Stiles, 1976; Weisz, 1980) indicates that motivation, academic achievement, and self-esteem are all significantly affected by this shared power.

In addition to the teacher's language, the students' language to themselves enhances or

inhibits their achievement (Ellis, 1977). The following activity may be used to help students understand the abstract concept of debilitating inner language. This exercise makes the abstract idea visible and concrete for all ages of students.

The Empowering Arm

> Ask for a student volunteer. Ask the student, "Which is your stronger arm?" Position the student in front of the class with the arm extended straight out to the side parallel to the floor. Tell the student, "I am going to try to bring your arm down to your side. Don't let me do it." Using both hands on the top of the student's arm push down gradually increasing your strength to see how much the student can resist. Now ask the student to say out loud to the class over and over, "I can't, I can't, I can't." When the student has repeated the statement several times, say, "Keep saying 'I can't' as you put your arm out to your side again. As you are repeating 'I can't,' I am going to try to put your arm down to your side. Don't let me do it." As the student repeats the phrase, you will find it is much easier to move the arm downward. Now ask the student to repeat "I can, I can, I can," over and over. Follow the same procedure and you will find the arm much stronger. Allow the student to try this procedure with a partner. Discuss the results. (Clark, 1986, p. 130)

Negative internal language can set students up to fail; therefore, that inner language needs to be changed. Teachers can use physical and verbal affirmation, humor, reflective questions, and constructive, specific, task-related feedback. Mistakes can be encouraged as clues to learning and errors valued for the information they give to both the teacher and the learner. By teaching effective communication skills to students, empowering language and behavior can become a shared concern, teacher to student, student to teacher, and among the student themselves.

Empowering Students Cognitively

Once the emotional function is positive and balanced we can begin to use the higher learning centers, the cortex, and the pre-frontal cortex. There is much that is still unknown about the functioning of these sections of the brain, however, there are some intriguing clues. The functions of the cortex will be the most familiar area of brain function for both teachers and students alike. What may not be as familiar is the notion of allowing the specializations of both hemispheres to support the cognitive process. Wittrock (1980) states that our brain hemispheres may specialize in the strategy of coding used rather than in the type of information encoded. The left brain is most responsible for linear, sequential, analytic, rational thinking. Thought of a metaphoric, spatial, holistic nature is the province of the right hemisphere. The right hemisphere seems better at passive comprehension, the left at active articulation.

It is important that we recognize not only the specialization of the hemispheres, but, also, the need for interaction and intersupport between the hemispheres. To reach our potential we must develop both types of functions and integrate our learning experiences. Concentration on the rational, cognitive functions of the brain will paradoxically limit these very functions. Without the support of a well-developed right hemisphere, left-brain growth will be inhibited. For years good teachers and parents have intuitively used both right- and left-brain functions in their teaching. The evidence for specialization now validates their teaching ideas. It was not by chance that we learned the alphabet easily by singing the alphabet song, math facts quickly with the help of the "inchworm" song, or days of the month from a repeated jingle. These rhythms helped us support the linear left-brain process with the spatial right-brain. Such strategies are powerful supports for learning. We could use them in the classroom.

Some of those who can help put these cognitive processes together are Feuerstein (1978) and his Instrumental Enrichment strategies, Buzan (1983) and his Mindmapping strategies, Gordon (1961) and his strategies for Synectics, and Suchman (1962) and his Inquiry strategies. These resources and many more just being developed will help you to integrate the specializations of the hemispheres to truly empower the learners cognitively.

Empowering the Learning Intuitively

A strange paradox exists in this area of function. According to neurobiologists, the prefrontal cortex is the most uniquely human area of the brain. It is species specific, that is, humans share this area of the brain with no other life form. The functions of this area, however, are those that are least discussed by researchers, least recognized by educators, and most ridiculed by otherwise intelligent, thoughtful people. These functions seem to include planning, insight, empathy, introspection, and other bases for intuitive thought (MacLean, 1978). The prefrontal cortex is engaged in firming up intention, deciding on action, and regulating our most complex behaviors (Restak, 1979). The prefrontal lobes of the cortex play a critical role in high level intellectual and emotional operations, curiously probing for and monitoring input, analyzing and synthesizing incoming information, excluding the irrelevant and then referring the new information to memory. Later these areas reconstruct from scraps whole and relevant memories, taking the outward leap of hunches and fantasy, guessing and postulating, carrying the mind into the future, making plans, shaping strategies for goals, forecasting, and then making readjustments to fit new perceptions and new goals. Emotionally they will provide empathy and cues to sociability, the basis for a communal spirit, and a moral sense (Loye, 1983). The prefrontal cortex is, in fact, the area that energizes and regulates all other parts: it houses our purpose.

Those most responsible for changing our culture (Plato, Newton, da Vinci, Einstein, etc.); important poets, musicians and artists (Keats, Mozart, Monet, etc.); philosophers, mathematicians, psychologists and educators (Pythagoras, Tesla, Jung, etc.); and modern scientists (Bohm, Prigogine, Pribram, etc.) all write about the use of intuition in their great discoveries and creative contributions. Although these abilities were highly valued by these eminent contributors to our culture, schools do nothing to enhance them, but rather ignore or actually inhibit their use.

Students can make impressive gains in areas of cognition, self-concept, and social-emotional development by using intuition-incorporation strategies. Among the cognitive gains are accelerated learning, higher levels of retention and recall, and higher interest in content. Other areas will show improvement in how competent the student feels, pleasure derived from learning, interpersonal relations, and teacher-student rapport (Bordan & Schuster, 1976; Galyean, 1977-80, 1978-81, 1979; Lozanov, 1977; Prichard & Taylor, 1980; Samples, 1975, 1977).

Some of the strategies that trigger intuitive processes are visualization, imagery, and fantasy. These can support learning in many ways including developing understanding of complex or abstract ideas to tapping previously known information and synthesizing it with current study. The following exercise will allow you to experience how visualization can change a physical function.

The Lemon Tree

> Very gently close your eyes . . . Imagine that you are just waking up in the morning in Southern California . . . It is a cool, clear day with just a hint of warmness . . . Feel the bed covers around you; . . . Stretch and begin to think about getting out of bed . . . Swing your legs over the side of the bed and slowly get to your feet . . . Put on your robe and walk out of the bedroom, through the living room, and onto the patio . . . Feel the cool cement of the patio . . . Walk into the yard and feel the soft grass on your feet, the dampness of the dew on the grass . . . Ahead of you is a lemon tree . . . Notice the dark green leaves, the dew on the leaves, the bright yellow lemons nestled among them . . . Walk up to the tree and reach out and pick the lemon closest to you . . . Feel the smoothness of the skin of the lemon, the coolness . . . Slightly damp with the dew . . . Now with your thumbnail slice into the skin of the lemon . . . Notice the spray that comes from the break in the skin; smell the tangy odor of the spray . . . Begin to pull off a part of the skin of the lemon . . . You can hear the membranes tear as you pull away pieces of the skin . . . Now push your thumbnail into the fruit of the lemon . . . Let the juice of the lemon flow over your hand, cool juice of the lemon flowing down onto your hand . . . Now stick your tongue into the hole in the lemon . . . Let the cool lemon juice trickle into your mouth, down your throat, lemon juice flowing into your mouth and throat . . . What are your salivary glands doing? Open your eyes . . . You don't have a lemon in your hand, but you have just changed a physiological function by using your imagination. (Clark, 1986, p. 167)

Summary

Each of the functions of the brain has been discussed. It is the integration of these functions that allows the human intelligence to express itself most fully. This is the purpose of the Integrative Education Model, to empower the learner physically, emotionally, cognitively, and intuitively. This Model is only one way of developing a more brain compatible curriculum and as you work with these ideas you will discover your own way of bringing this integration into your classroom. It is only as these new ideas become a part of your professional judgement and experience that the information will become meaningful and of benefit to all learners, especially those who face the challenge of a rapidly developing intellect, the gifted.

As we have seen, giftedness is not just an interesting idea. These learners cannot get along by themselves if they are to become the most they can be. Unless allowed to use what they have they will surely lose it. If we are to have excellence in our schools we must believe it to be important. Your attitude and your belief can make it happen. I invite you to believe that change is possible, that potential is unlimited and that each of us has a unique contribution to make. The new information will allow us to be more effective and efficient, and as educators, we are in a position to make important changes. I invite you to join the adventure, and experience the excitement. Together we can optimize learning.

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